HPLS®-2G

HEADING, POSITIONING & LEVELING SYSTEM

User Guide

VERSION 1.00

JULY 2025

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ABBREVIATIONS

Abbreviation	Description
AHRS	Attitude Heading Reference System
BIN Message	Binary Message
CEP	Circular Error Probability
CSEP	Calculated Separation
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
MSEP	Measured Separation
N/A	Not Available
N/C	Not Connected
RMS	Root Mean Square
TBD	To Be Determined
UKF	Unscented Kalman Filter
VG	Vertical Gyro

WARRANTY NOTICE

This Warranty covers products manufactured by Arazim, Ltd. (The "Company")

The Company warrants the products during the Warranty Period, under normal use and maintenance, to be free from defects in material and workmanship, and will substantially conform to the Company's specifications (attached) for the products. Yet the Company does not guarantee that the product will not endure any interruptions or faults. The product datasheet, specifications and additional instructions are included in the User Manual.

This Warranty shall apply to all parties. All other warranties or settlements are excluded.

In order to obtain a warranty service, the purchaser must provide the original purchase Invoice and serial number of the product.

The Purchaser is responsible for installing the product properly and to check and verify the functioning of the product. For any faults or claims the purchaser must contact and notify the Company within 14 days of the purchase of the product.

For any faults or deficiency on the purchaser's liability:

1) Return Merchandise Authorization (RMA) Report must be issued.

2) Non Conformance Report including Product Serial Number must be attached.

3) Transport of the product to and from Arazim Ltd. offices.

The Warranty shall apply only in Israel and is subject to the availability of replacement parts. The Company will not change the design or functionality of the product in order to conform to restrictions of countries in which the product is restricted for legal or regulation issues.

This warranty shall comply with all governed regulations for the products including all Import and export regulations and inspections.

Warranty Period for the company products is for 12 months unless stated otherwise by the Company. The warranty Period applies from the purchase date indicated on the purchase invoice. For products carrying longer Warranty Periods, all of the foregoing liabilities stated above will apply during the second- and third-year warranty periods (excluding payment collections) In addition the Company will not be obligated to the repair lead times.

The Company may charge for repairs or replacements if required under any of the following conditions:

- Damage caused by accident or natural events such as fire/water; electrical discharges; Use of hardware or software, interfaces or devices not supplied by the Company and/or are not manufactured by Arazim, Ltd.
- Malice, negligence, abuse, misuse, or improper installation of the products not complying with the user manual; expandable parts, external cover, or color coatings; damage occurring in transport of the product by the Purchaser.
- Any changes, repairs or services performed on the product by any party other than Arazim, Ltd. including removal of the seal tag protecting the inner parts of the product from exposure.
- The Company is not obligated to adjust the product to any designation or purpose.
- The Company will not be liable for any claim by purchaser or any third party of direct or indirect damage including loss or deletion of applications or information, restoration expenses, loss of time and or profit, reputation damages including damages resulting using the product, any faults or services provided for the product.
- Any repair services for the products after the expiration of the warranty Period will bear charges.

The warranty and repair service will be executed in Israel and subject to the discretion of the Company whether to exchange parts, repair or replace the product. The product or parts may be reconditioned parts or used parts but will, in all cases, be functionality equivalent to the original parts or even improved.

This Warranty Notice will apply to all parties and in lieu of any other agreements or contradictions.

TABLE OF REVISIONS

Ver. #	Description	Author/s	Date

1. INTRODUCTION

1.1. About the HPLS®-2G

HPLS®-2G is a GNSS-Based, North Finding System solution, for the Heading Positioning and Leveling System.

The HPLS®-2G products family provides cost-effective and highly professional, small, rugged solution for static and low dynamic orientation needs.

The HPLS®-2G provides improved heading accuracy of down to 0.04° and below (Multi-Frequency system at 2 m antenna separation), as well as an improved rugged Mil-Spec compliance package. With an update rate of up to 20 Hz, the HPLS®-2G can meet the needs of many applications, ranging from Antenna Positioning Systems to Accurate Target Acquisition Systems.

The HPLS®-2G-BAR version of the family is an ultra-rugged, bar-based solution that provides a cost-effective, highly professional, miniature, rugged solution to meet static orientation and attitude needs.

The HPLS®-2G multi-frequency versions implement advanced new proprietary algorithms with improved smooth results in real-time conditions.

The HPLS®-2G family of systems is based on GNSS and Antenna technology that analyzes raw data from GNSS satellites that arrive at two antennas, separated by a short distance (typically 0.5 - 2 m), so that accurate Heading information can be obtained. Unlike traditional magnetic-based heading systems, this system is not affected by a magnetic environment.

The key features of the HPLS®-2G include:

- An extremely affordable solution for Heading, Attitude, and Position
- Heading Accuracy down to 0.04° (1-sigma)
- Roll/Pitch accuracy of 0.15° (1-sigma) over Full-Temp-Range
- Update Rate to 20 Hz (Heading & Position)
- High-Precision, DGNSS position accuracy of 60cm – 95% of the time
- Small Form Factor System
- Support for several types of antennas
- Mil-Spec Compatibility

Typical HPLS®-2G applications include:

- Antenna Positioning Systems
- Accurate Marine Compass and Positioning Systems
- Optical Observation Systems
- Target Acquisition Systems
- Radar North Finding Systems

1.2. How the HPLS®-2G Works

The HPLS®-2G uses a carrier phase-based, precise Heading and Pitch estimates with Global Navigation Satellite System (GNSS) receivers. These receivers normally use altitude and heading estimation methods, based on multi-antenna deployment, to obtain precise and reliable heading and pitch estimates. These estimates, based on Time-Differenced Carrier Phases (TDCPs), determine the precise delta between antenna positions in two consecutive epochs.

The components of the estimated receiver's delta position account for any motion constraints and the heading and pitch angles of a moving land vehicle.

A threshold length for the delta position is set to avoid large errors during static periods.

1.2.1. Tilt Measurement

The HPLS®-2G uses a factory-calibrated internal tilt sensor to measure the HPLS®-2G housing inclination, which does not affect Heading calculations.

2. UNPACKING THE HPLS®-2G

2.1. Overview

Figure 1 is an example of a packed HPLS®-2G system, which is shipped to the customer, according to a specific ordering part number.

You can purchase the parts separately or together (as a system). The information in Table 1 is an example of a parts list.

Figure 1. HPLS®-2G Parts

2.2. HPLS®-2G Parts List Example

Table 1. HPLS®-2G Parts List Example

Part ID	Part Name	Quantity	P/N
A	HPLS®-2G	1	HPLS-XXXXX-XXX
B	Cable HPLS®-2G	2	HPLS-CAB-003
C	Cable RG58 3-meter TNC to TNC	2	HPLS-CAB-070
D	GNSS ANT, L1, L2, L5	1	HPLS-ANT-200
E	ATR / Test report	1	
F	CD or DOK	1	

3. INSTALLING THE HPLS®-2G

3.1. Mounting the Antennas

It is possible to mount the HPLS®-2G antennas in any orientation available on the carrying platform axis.

However, the Heading Installation (which orients the antennas parallel to, and along the centerline of, the carrying platform axis) is the most common, and provides a true Heading, without the need to offset the true Heading calculation.

Note	Be sure to offset the true Heading calculation if the antennas are not mounted with the Heading Installation method.

3.1.1. Planning the Optimal Antennas Placement

Optimal antenna placement results in a more accurate GNSS reading.

Be sure to place the antennas:

- as high as possible
- along the centerline of the platform
- on a level plane
- with a clear view of the horizon
- away from radio frequencies
- away from other electronics and antennas

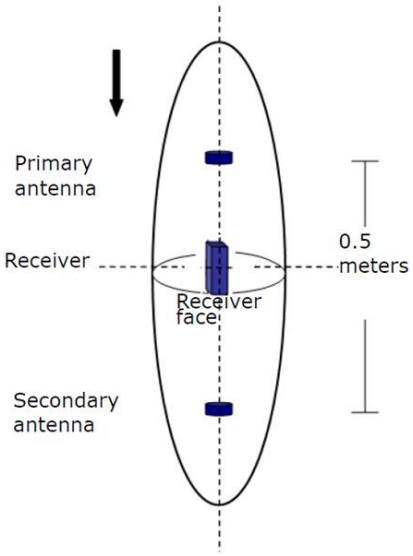


Figure 2. Mounting Antennas

3.1.2. Routing and Securing the Antenna Cable

When routing and securing antenna cables, be sure that:

- The two enclosed antennas have a 50 Ω impedance antenna extension cable such as RG-58U (up to a maximum of 15 m (49 ft.) long).
- The GNSS engine inside the HPLS®-2G has a minimum input gain of 10 dB (and maximum input gain of 40 dB before saturation). For example, the antennas that offer 28 dB of gain permit the loss budget to accommodate cable losses of less than 18 dB.
- cable losses are less than 18 dB of attenuation (regardless of cable material and length). Due to variances in the antenna gain and practical attenuation of cable materials and connectors, we recommend an attenuation of 15 dB to overcome the resulting RF cable attenuation.

3.1.3. Relationship between Cable Length and Antenna Location

Cable length is a key factor in antenna location since a longer cable results in a higher decibel loss than a shorter one. If the overall decibel loss of the longer cable exceeds 15 dB, it may be necessary to use a larger, less flexible, and more expensive cable. The HPLS®-2G comes with standard RG58 cables whose attenuation is approximately 0.8 dB/m. The nominal decibel loss of these cables is within the tolerable budget of approximately 10 dB. If a cable length of 15-20 m is required, use an RG8 cable. However, cables longer than 20 m require more sophisticated cable materials.

Table 2. Antenna Cable Loss

Material	Loss @ GNSS L1 (1.575 GHz)
RG8	0.36 dB/m
RG58	0.78 dB/m
Times Microwave LMR400	0.15 dB/m

3.2. Mounting the Receiver

When mounting the HPLS®-2G receiver, be sure to:

- install the receiver in a location that minimizes vibration, shock, extreme temperatures, and moisture.
- position the receiver horizontally.

3.3. Connecting Cables for Power and Serial Ports

When connecting cables, be sure to:

- run cables far from areas of excessive heat and away from doors or window jams.
- keep cables away from corrosive chemicals and rotating machinery.
- avoid placing tension on cables or crimping or bending them excessively.
- remove unwanted slack from the cables at the receiver end.
- secure the cable route with plastic tie wraps.

3.3.1. HPLS®-2G Power Source

The power source for the HPLS®-2G must be between 14VDC and 32VDC (regulated).

4. APPENDIX A: ELECTRICAL CONNECTIONS

4.1. Overview

This Appendix contains the connector part numbers, matching connectors and the connector pinout descriptions.

Figure 3. 3D View of the HPLS®-2G Receiver

The HPLS®-2G is equipped with three connectors — two for the GNSS antenna and a third (integrative) connector that interfaces with the host controller and the input power supply.

Table 3. HPLS®-2G Panel Connector Part Numbers (Cable BOM)

Connector	Manufacturer	Part Number	Mate With	Description
TNC, Jack (Socket)	Amphenol RF	122192-15	122108	GNSS Antenna
MIL-D38999 II	Amphenol Aerospace	D38999/24WD-35PN	D38999/26WD-35SN	Power & Data

4.1.1. Interface/Power Connector - Internal Pinout Description

Power Data Pin No 1-20		Target Connectors	Remarks
		Banana Plug Red	
1	→		Vin
2	→		Vin
3	→	Shield	
		Banana Plug Black	
4	→		GND
5	→		GND
		D-Type 9pin Port-A	RS232
6	→	2	TxD
7	←	3	RxD
8	→	5	GND
		D-Type 9pin Port-B	RS232
9	→	2	TxD
10	←	3	RxD
11	→	5	GND
		Factory Reserved	
12	→		
13	←		
14	→		
		Factory Reserved	
15	→		
16	←		
17	→		

Power Data Pin No 21-37		Target Connectors	
		PPS	
18		Non Inverting	
19		Inverting	
20		GND	
		LED Board	
21		3.3v	
22		GND	
23		GPS P Lock	
24		DGPS Lock	
25		DIFF Lock	
26		GPS S Lock	
27		Heading	
		Port-A	Optional RS422
28		TX+	
29		TX-	
30		RX+	
31		RX-	
32		GND	
33		V422	Optional – RS422 Ext. Power Supply
34		Factory Use	
35		Factory Use	
36		Short Pin-A	
37		Short Pin-B	

5. APPENDIX B: MECHANICAL INFORMATION

This appendix contains various HPLS®-2G series connections, views, and dimensions.

5.1. HPLS®-2G

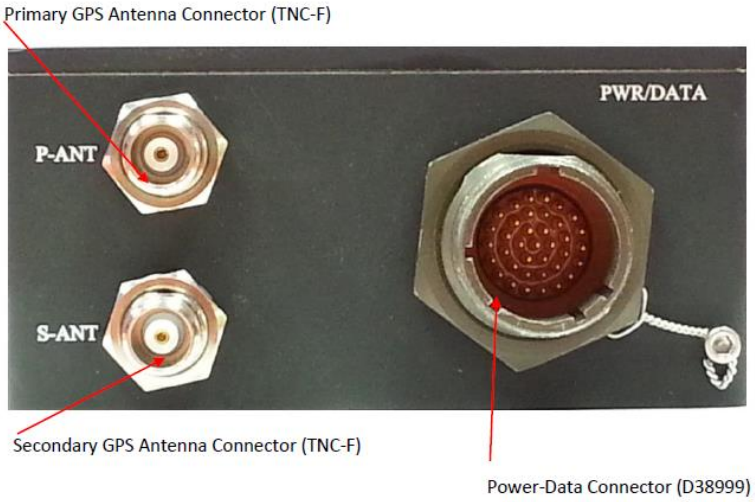


Figure 4. Front Panel Connections

Figure 5. HPLS®-2G Top View

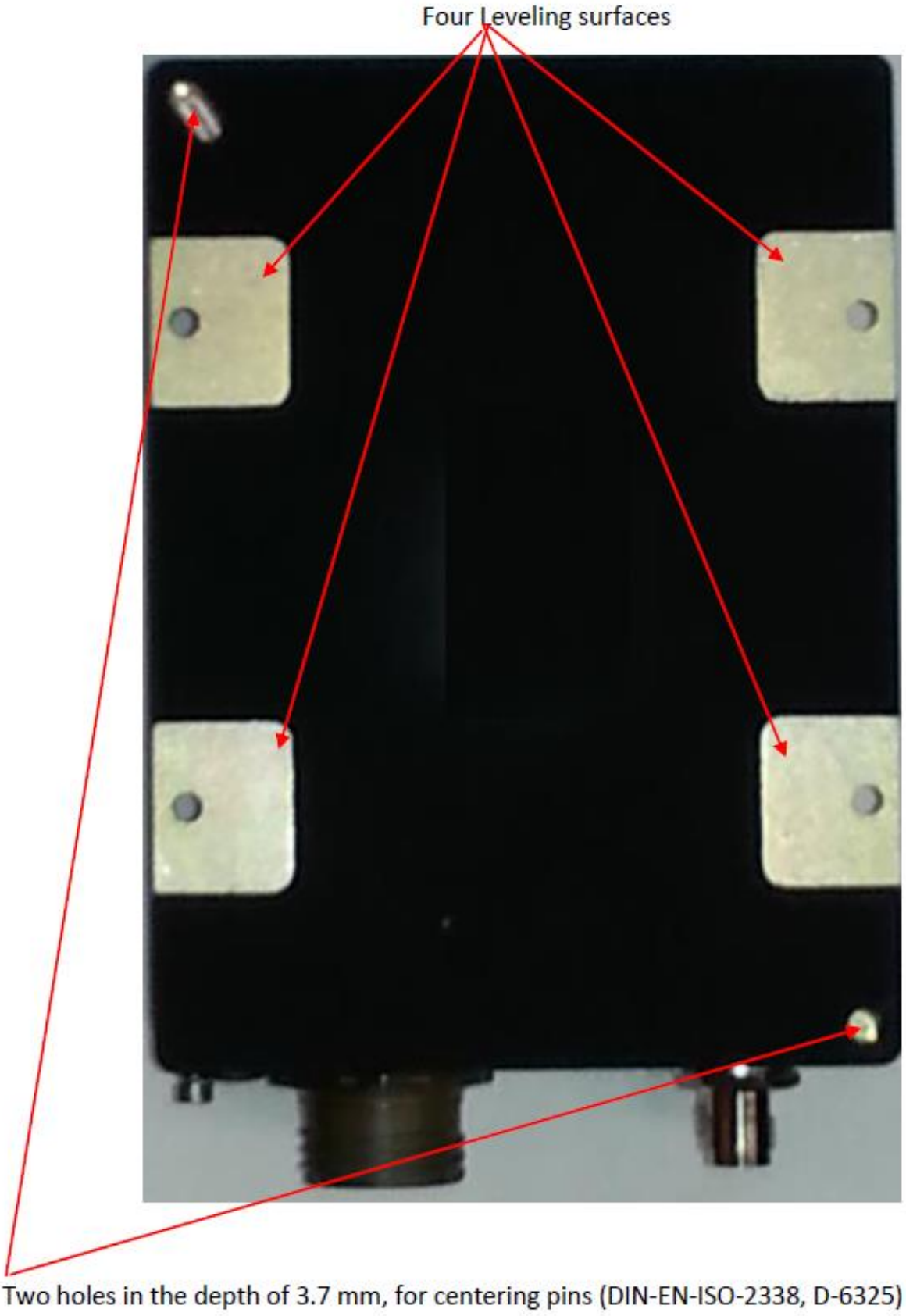


Figure 6. HPLS®-2G Bottom View

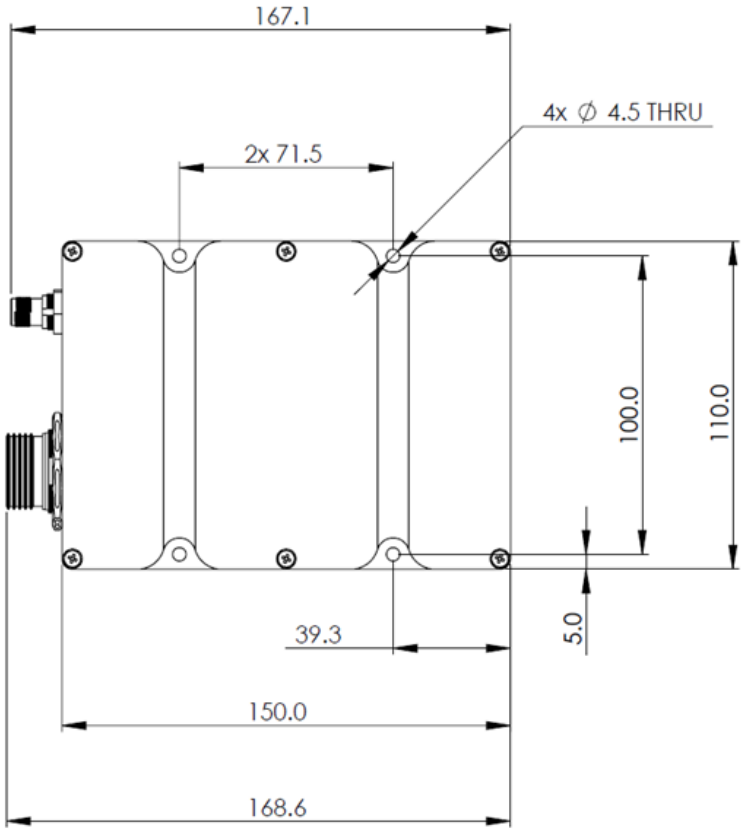


Figure 7. HPLS®-2G Top View

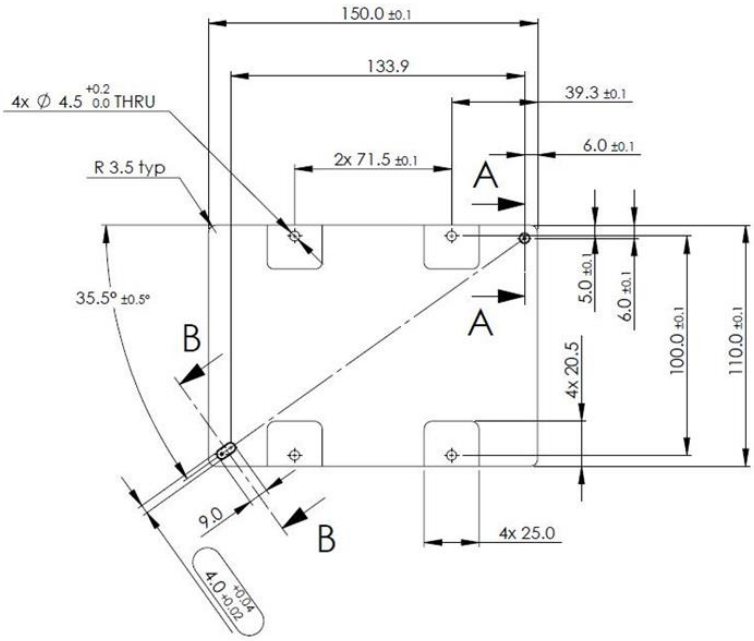


Figure 8. HPLS®-2G Bottom View

5.2. HPLS®-2G – BAR 0.5

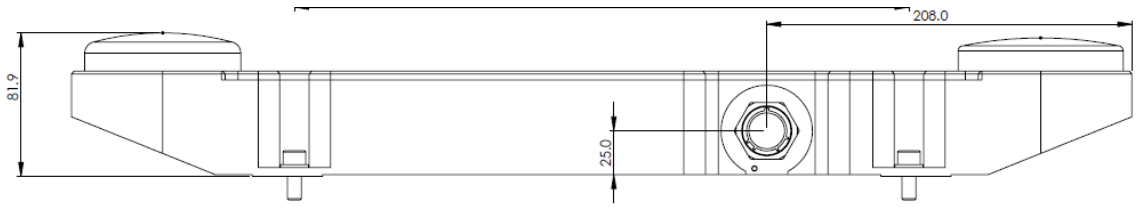


Figure 9. HPLS®-2G – BAR 0.5 Front Panel Dimensions

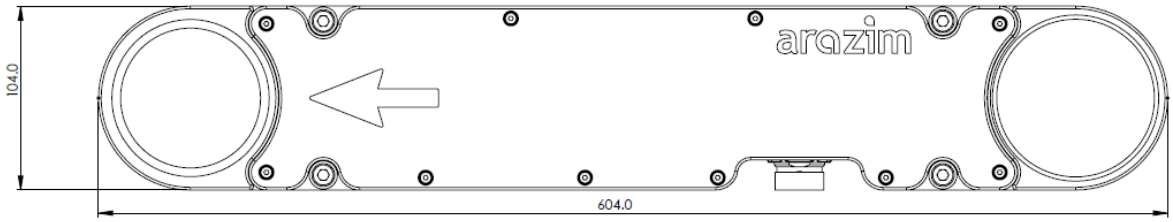


Figure 10. HPLS®-2G – BAR 0.5 Top View

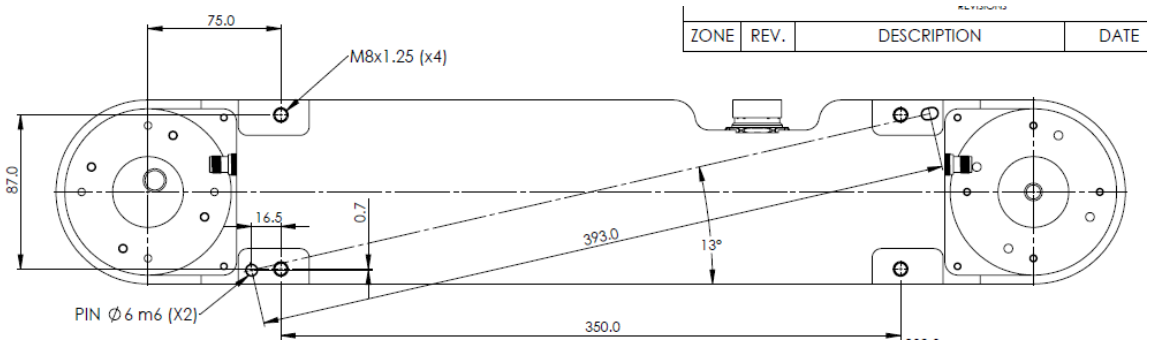


Figure 11. HPLS®-2G – BAR 0.5 Bottom View

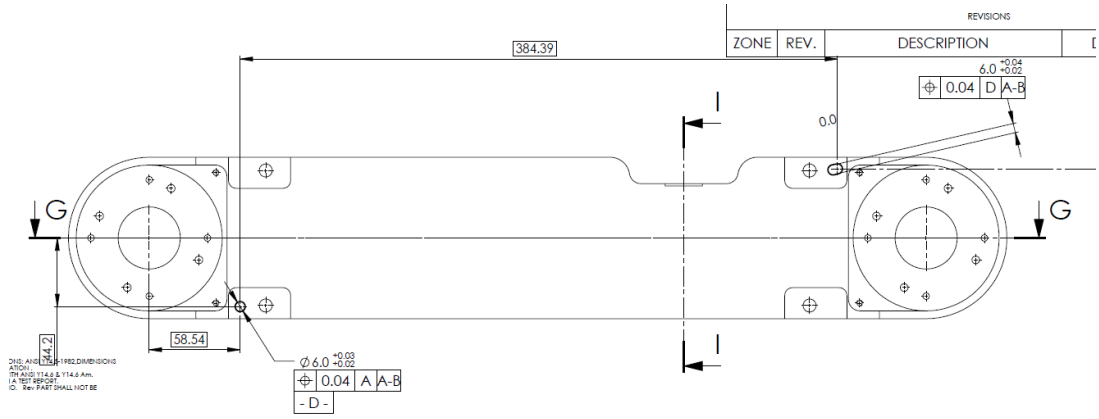


Figure 12. HPLS®-2G – BAR 0.5 Body Connections

6. APPENDIX C: POWER UNIT

6.1. Overview

This appendix contains information on the HPLS®-2G power unit, which was redesigned to comply with MIL-STD-1275B and EMI/RFI, according to MIL-STD-461C.

6.1.1. Power Unit Main Features

The power unit operates according to the standards listed in Table 4.

Table 4. Power Unit Operating Standards

Standard	Details
Reverse protection	
MIL-STD-461C	EMI/RFI
MIL-STD-1275B	Under Voltage protection: 6v/1Sec.
	Surge protection: 100v/50mSec
Working band	14VDC to 32VDC

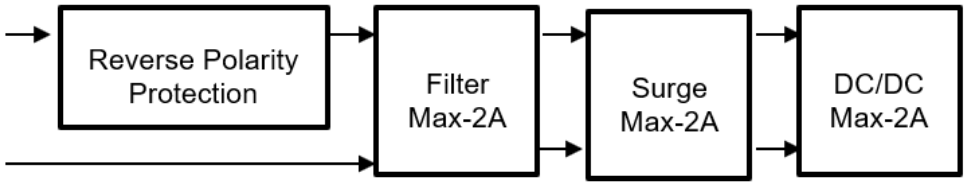


Figure 13. Main Power Unit Block Diagram

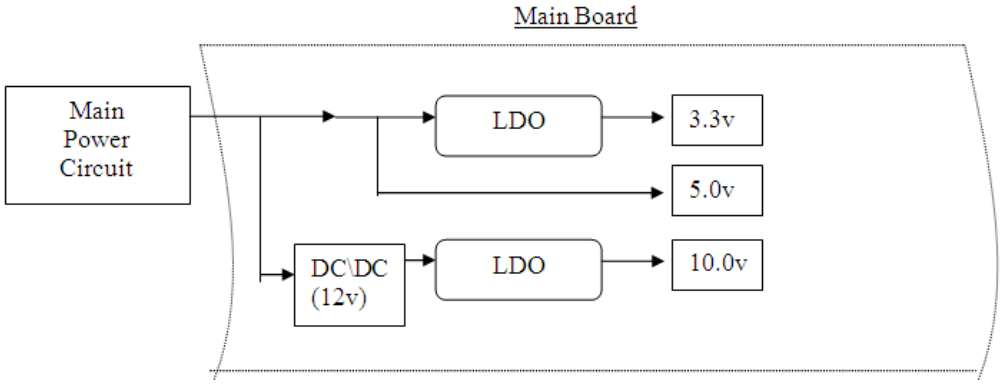


Figure 14. Full Power Supply Block Diagram

7. APPENDIX D: SPECIFICATIONS

7.1. Overview

This appendix contains various HPLS®-2G specifications.

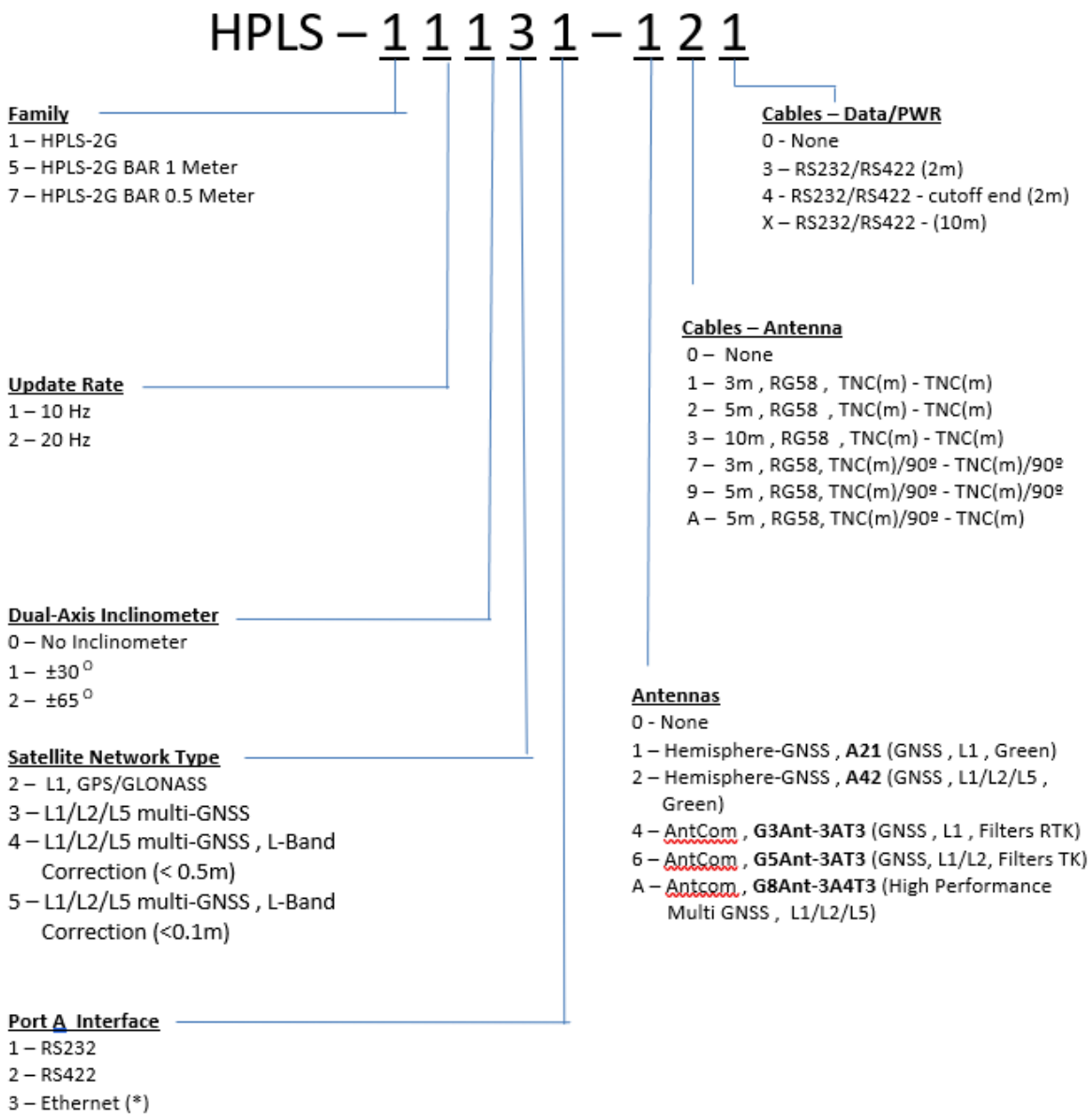
Table 5. HPLS®-2G Specifications

Parameter	Single Frequency	Multi-Frequency
GNSS Sensor		
Receiver Type	L1, GNSS, GLONASS, BeiDou, Galileo, QZSS, SBAS, L-band corrections GNSS L1CA/L1P GLONASS G1, P1 BeiDou B1 GALILEO E1BC QZSS L1CA4	L1/L2/L5 Multi-Frequency Multi-Constellation. GNSS, GLONASS, BeiDou, Galileo, QZSS, IRNSS, SBAS, L-band corrections GNSS L1CA/L1P/L1C/L2P/L2C/L5 GLONASS G1/G2/G3, P1/P2 BeiDou B1i/B2i/B3i/B10C/B2A/B2B/ACEBOC GALILEO E1BC/E5a/E5b/E6BC/ALTBOC QZSS L1CA/L2C/L5/L1C/LEX NavIC (IRNSS) L5
Update Rate Horizontal Accuracy	10 Hz Position & Heading (optional 20Hz) < 60 cm 95% confidence (DGNSS)** < 2.5 m 95% confidence (autonomous no SA) ***	10 Hz Position & Heading (optional 20Hz) < 60 cm 95% confidence (DGNSS)** < 2.5 m 95% confidence (autonomous no SA) ***
Heading Accuracy	< 0.30º (1-sigma) @ 0.5m antenna separation < 0.15º (1-sigma) @ 1.0m antenna separation < 0.08º (1-sigma) @ 2.0m antenna separation	< 0.17º (1-sigma) @ 0.5m antenna separation (<0.20º for HLPS-2G-BAR 0.5) < 0.08º (1-sigma) @ 1.0m antenna separation < 0.04º (1-sigma) @ 2.0m antenna separation
Rate of Turn	100º/sec maximum	100º/sec maximum

Parameter	Single Frequency	Multi-Frequency
Startup Time	< 60 sec typical	< 60 sec typical
Heading Fix	< 20 sec (after startup / position fix)	< 20 sec (after startup / position fix)
Satellite Reacquisition	< 1 sec	< 1 sec
Inclinometer Sensor		
Pitch & Roll Range	±30° (optional ±60°)	
Pitch & Roll Accuracy	< 0.15° (1-sigma) over Full-Working-Temp-Range	
Update Rate	10Hz	
Communications		
Serial Ports	RS-232 port A, PC levels, (optional RS-422) – Heading / Position / Roll / Pitch RS-232 port B, PC levels - Setup / NMEA msg. out	
Baud Rates	115,200 bps - 921,600 bps	
Data I/O Protocol	Port A - Binary (Proprietary) Port B - NMEA 0183	
Timing Output	1 PPS, Accuracy 30 nS, CMOS level output / Differential output.	
Power		
Input Voltage	14 VDC - 32 VDC	14 VDC - 32 VDC
Current Consumption	< 380 mA @ 14 VDC (typical)	< 890 mA @ 14 VDC (typical)
Mechanical		
Dimensions	Bar 0.5m separation - 604 x 104 x 92 mm (with antennas) Center box - 150 x 110 x 55 mm (without antennas)	
Weight	Bar 0.5m separation - 3.85 Kg (with antennas) Center box - < 1 Kg (without antennas)	
Status Indication	Power, 1PPS, Primary GNSS, Secondary GNSS, Differential, DGNSS, Heading	
Power/Data Connectors	D38999/24WD35PN	
Antenna Connectors	2 x TNC (female)	

Parameter	Single Frequency	Multi-Frequency
Environmental		
Temperature – Operating	-40º C to +71º C	-40º C to +71º C
Temperature – Storage	-40º C to +85º C	-40º C to +85º C
Humidity	95% non-condensing	95% non-condensing
Compliance (Design to-Spec)		
Temperature	-40ºC to +71ºC Mil-Spec 810-G Method 501.5 Procedure II	
Humidity	95% non-condensing Mil-Spec 810-G Method 507.5 Procedure II	
Shock	20g, 11 msec ½ Sine Mil-Spec 810-G Method 516.6 Procedure V	
Vibration	6.5 grms, 5-800 Hz Mil-Spec 810-G Method 514.6 Procedure I, Category 4, Table 514.C6-IV	
Enclosure	IP67 EN 529	
Rain	Mil-Spec 810-G Method 506.5 Procedure I	
Dust	Mil-Spec 810-G Method 510.5 Procedure I	
Salt/Fog	Mil-Spec 810-G Method 509.5	
Altitude	RTCA/DO-160D, Section 4, Par 4.6.1	
Power Supply	MIL-STD-1275B	
EMI/RFI	MIL-STD-461C/D	
MTBF	> 50,000 hours according to Mil-HDBK 217	

8. APPENDIX E: ORDERING INFORMATION



*Long Lead Time (LLT)

Antenna cables Ordering Info

HPLS – CAB – 0 2 0

Cables – Antenna
1 – 3m , RG58 , TNC(m) - TNC(m)
2 – 5m , RG58 , TNC(m) - TNC(m)
3 – 10m , RG58 , TNC(m) - TNC(m)
7 – 3m , RG58, TNC(m)/90º - TNC(m)/90º
9 – 5m , RG58, TNC(m)/90º - TNC(m)/90º
A – 5m , RG58, TNC(m)/90º - TNC(m)

Power / Data cables Ordering Info

HPLS – CAB – 0 0 3

Cables – Data/PWR
3 – RS232/RS422 (2m)
4 – RS232/RS422 - cutoff end (2m)
X – RS232/RS422 - (10m)

Antennas Ordering Info

HPLS – ANT – 1 0 0

1 – Hemisphere-GNSS , **A21** (GNSS , L1 , Green)
2 – Hemisphere-GNSS , **A42** (GNSS , L1/L2/L5 , Green)
4 – AntCom , **G3Ant-3AT3** (GNSS , L1 , Filters RTK)
6 – AntCom , **G5Ant-3AT3** (GNSS, L1/L2, Filters TK)
A – Antcom , **G8Ant-3A4T3** (High Performance Multi GNSS , L1/L2/L5)

9. APPENDIX F: TROUBLESHOOTING

9.1. Overview

This chapter contains solutions for issues that users commonly encounter while working with the HPLS®-2G system.

9.2. HPLS®-2G

Issue 1:

No messages are received from Port A when powering up the HPLS®-2G system.

Solution 1:

1. Turn the system off.
2. Wait five seconds.
3. Turn the system on.

Issue 2:

The heading value remains zero, even when I receive location information.

Solution 2:

For both static and dynamic modes, ensure that:

- The antennas are properly connected to the HPLS®-2G.
- The antennas are under open sky.
- The antennas are on a flat surface.
- The distance between the centers of the antennas was measured correctly.
- The value of the measured distance was entered into the MSEP field.
- Read the CSEP value to verify the correlation between the measured and calculated values.

Issue 3:

Shortly after activating the HPLS®-2G system, messages are received without location information.

Solution 3:

1. If the GNSS BIT indicator is green in the "Turn On – BIT" frame, ensure that:
   a. The antennas are located under open sky.
   b. The cables between the HPLS®-2G and the antennas are connected properly.
2. If the GNSS bit indicator is red in the "Turn On – BIT" frame:
   a. Turn the system off.
   b. Wait several seconds.
   c. Turn the system on.

For additional installation information, see:
HPLS®-2G User Guide, Chapter 3.